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TI Working and heat treatment of copper alloys for electric contacts and the alloys
IN Hirai, Takao
PA Furukawa Electric Co., Ltd., Japan
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AB The processes are carried out by (a) working followed by (b) heat treatment, under conditions for controlling the changes in the Vickers hardness to be ≤10 before and after each of the processes. The claimed Cu alloys contain Sn 0-10, Zn 0-40, Ni 0-10, Fe 0-3, Cr 0-1, Mn 0-1, P 0-0.5, Si 0-1, Mg 0-1, Zr 0-0.5, Ti 0-1, Co 0-1, Ag 0-1, Al 0-5, B 0-0.5, and/or rare earth metals 0-0.5 weight%. The alloys are used in elec. terminals and switches including springs.

Notes:

1. Untranslatable words are replaced with asterisks (****).
2. Texts in the figures are not translated and shown as it is.

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Dictionary: Last updated 03/16/2007 / Priority: 1. Electronic engineering / 2. Chemistry / 3. Mechanical engineering

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FULL CONTENTS

[Claim(s)]

[Claim 1] They are a fabricating operation and the thermomechanical treatment method of the copper alloy for electric lines or cable material which heat-treats after that. It is processed so that Vickers hardness (Hv) change of a processing part before and after carrying out the fabricating operation of said copper alloy for electric lines or cable material as a spring from a raw material may become less than ten. Subsequently, the thermomechanical treatment method of the copper alloy for electric lines or cable material characterized by performing heat treatment which makes Vickers hardness (Hv) change of said part before and after this heat treatment less than ten when it heat-treats.

[Claim 2] It is the thermomechanical treatment method of the copper alloy for electric lines or cable material according to claim 1 characterized by performing heat treatment after said fabricating operation for 5 to 10000 seconds at the temperature of 200-800 degrees C.

[Claim 3] It is processed so that Vickers hardness (Hv) change of a processing part before and after carrying out a fabricating operation as a spring from a raw material may become less than ten. Subsequently, any one sort of the following component composition for performing heat treatment which makes Vickers hardness (Hv) change of said part before and after this heat treatment less than ten when it heat-treats, or two sorts or more are included. The copper alloy for electric lines or cable material with which the remainder consists of Cu and unescapable impurities (in the following, it means additive-free "0 wt%").

Sn: 0 - 10wt%, Zn: 0 - 40wt%, nickel: 0 - 10wt% Fe:0 - 3wt%, Cr: 0 - 1wt%, Mn: 0 - 1wt% P:0 - 0.5wt%, Si: 0 - 1wt%, Mg: 0 - 1wt% Zr:0 - 0.5wt%, Ti: 0 - 1wt% Co:0 - 1wt% Ag:0 - 1wt% aluminum:0 - 5wt% B:0 - 0.5wt% Rare earth elements: 0 - 0.5wt%.

[Claim 4] The heat treatment performed after said fabricating operation is a copper alloy for electric lines or cable material according to claim 3 characterized by being for 5 to 10000 seconds at the

temperature of 200-800 degrees C.
[Claim 5] Said copper alloy for electric lines or cable material is nickel. : 1 - 4 wt%, Si : Copper alloy for electric lines or cable material according to claim 3 or 4 characterized by the remainder being the copper alloy which consists of Cu and unescapable impurities 0.1 - 1.0 wt%.
[Claim 6] Said copper alloy for electric lines or cable material is nickel. : 1 - 4 wt%, Si : 0.1 - 1.0 wt%, Furthermore, the copper alloy for electric lines or cable material according to claim 3 or 4 characterized by being the copper alloy with which the remainder consists of Cu and unescapable impurities one or more sorts chosen from Sn, Mn, Mg and Zn, Ag, and Co including 0.005 - 1wt% in a total amount.
[Claim 7] Said copper alloy for electric lines or cable material is Sn. : 0.5 - 3 wt%, P : Copper alloy for electric lines or cable material according to claim 3 or 4 characterized by the remainder being the copper alloy which consists of Cu and unescapable impurities 0.005 - 0.5 wt%.
[Claim 8] Said copper alloy for electric lines or cable material is Sn. : 0.5 - 3 wt%, P : 0.005 - 0.5 wt%, Furthermore, 0.005 - 2wt% is included for one or more sorts chosen from nickel, Mn, Fe, Cr, Mg, and Zn in a total amount, and the remainder is Cu. And copper alloy for electric lines or cable material according to claim 3 or 4 characterized by being the copper alloy which consists of unescapable impurities.
[Claim 9] Said copper alloy for electric lines or cable material is Sn. : 3 - 10 wt%, P : Copper alloy for electric lines or cable material according to claim 3 or 4 characterized by the remainder being the copper alloy which consists of Cu and unescapable impurities 0.005 - 0.5 wt%.
[Claim 10] Said copper alloy for electric lines or cable material is Sn. : 3 - 10 wt%, P : 0.005 - 0.5 wt%, Furthermore, the copper alloy for electric lines or cable material according to claim 3 or 4 characterized by being the copper alloy with which the remainder consists of Cu and unescapable impurities one or more sorts chosen from nickel, Fe, and Zn including 0.005 - 2wt% in a total amount.
[Claim 11] Said copper alloy for electric lines or cable material is Zn. : 5 - 35 wt%, Copper alloy for electric lines or cable material according to claim 3 or 4 characterized by the remainder being the copper alloy which consists of Cu and unescapable impurities.
[Claim 12] Said copper alloy for electric lines or cable material is Zn. : 0.005 - 5wt% is further included for one or more sorts chosen from Sn, nickel, and Fe in a total amount 5 - 35 wt%, and the remainder is Cu. And copper alloy for electric lines or cable material according to claim 3 or 4 characterized by being the copper alloy which consists of unescapable impurities.

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the thermomechanical treatment method and the copper alloy for electric lines or cable material of the copper alloy for spring **** electric lines or cable material used for an electric terminal, a switch, etc.

[0002]
[Description of the Prior Art] the member for electric lines or cable material using the spring characteristics of the metallic material is common -- what is called the electric connection mechanism of a terminal and a switch -- metaled spring nature -- with -- **** -- it is making partner material contact firmly and obtaining electric connection in most cases. It is having structure as shown in drawing 1 typically, and the tongue-shaped piece 42 of the female terminal 4 achieved the role rate of the spring, when the male terminal 2 was inserted, the spring bent, and the terminal of the core box that in a car etc. used has acquired contact force with the male terminal 2 with the reaction force.
[many]
[0003] In order to raise the reliability of an electric point of contact, various approaches are made, for example, techniques, such as making high surface treatment by plating etc. and contact force (it being henceforth called ****), are used widely. This contact pressure always is not constant, by repeating insert and remove, "setting" arises in a spring part, the case where it becomes impossible to obtain sufficient contact pressure, and a metal department produce creep, and a contact pressure decreases gradually in many cases (stress relaxation phenomenon).
[0004] Especially the board thickness of the plate material which is carrying out the small thinning of the electrical connector itself with the miniaturization of apparatus in recent years, and is used is becoming thin steadily. Even when obtaining the same contact pressure, if a plate becomes thin, it is necessary to take many amounts of deflections of a spring, and the maximum stress concerning a plate is so high that it does not become before and a pigeon ratio BE object. As a result, it is easy to produce the setting by insert and remove.
[0005] Moreover, especially the connector for cars is the situation and intermediary **** in which the environmental temperature used tends to carry out stress relaxation by becoming high. In view of the situation which such aging of a contact pressure tends to produce, designing an early contact pressure highly especially is performed so that a necessary minimum contact pressure can be maintained over a long period of time.
[0006] On the other hand, the pole of a connector is increasing from buildup of an input/output terminal number, and the increase in the insert-and-remove force at the time of the insert and remove of a connector has been a problem. That is, the insert-and-remove mosquito which needs it at a multipolar connector when that the contact pressure of a pair of contacts becomes high slightly respectively also carries out the insert and remove of the connector serves as a big change. For example, although the connector is made to fit in by an ordinary person's hand at the time of the assembly of a car, if the insert-and-remove force becomes high, the load buildup at the time of an assembly and aggravation of working efficiency are brought about.
[0007] Thus, although he wants to make an early contact pressure high, the actual condition is having lapsed into dilemma in the opposite desire referred to as wanting to suppress the insert-and-remove force low. In order to suppress insertion force low, keeping a contact pressure high, and to obtain a low friction coefficient, surface treatment is also advanced [though natural,], but the technology which is compatible in electric reliability and a low friction coefficient is not developed.

[0008]
[The technical problem [****] which it is going to solve] the electric lines or cable material with little aging of a contact pressure also to ** in which this invention does not make an early contact pressure high in view of this -- public funds -- it aims at offer of a group spring member.
[0009]
[Means for Solving the Problem] The 1st mode of invention is a fabricating operation and the thermomechanical treatment method of the copper alloy for electric lines or cable material which heat-treats after that. It is processed so that Vickers hardness (Hv) change of a processing part before and after ******(ing) said copper alloy for electric lines or cable material as a spring from a raw material may become less than ten. Subsequently, when it heat-treats, it is the thermomechanical treatment method of the copper alloy for electric lines or cable material characterized by performing heat treatment which makes Vickers hardness (Hv) change of said part before and after this heat treatment less than ten.
[0010] The 2nd mode of invention is the thermomechanical treatment method characterized by performing heat treatment after said fabricating operation for 5 to 10000 seconds at the temperature of 200-800 degrees C.
[0011] The 3rd mode of invention is processed so that Vickers hardness (Hv) change of a processing part before and after carrying out a fabricating operation as a spring from a raw material may become less than ten. Subsequently, any one sort of the following component composition for performing heat treatment which makes Vickers hardness (Hv) change of said part before and after this heat treatment less than ten when it heat-treats, or two sorts or more are included. The copper alloy for electric lines or cable material with which the remainder consists of Cu and unescapable impurities (in the following, it means additive-free "0 wt%").
Sn: 0 - 10wt%, Zn: 0 - 40wt%, nickel: 0 - 10wt% Fe:0 - 3wt%, Cr: 0 - 1wt%, Mn: 0 - 1wt% P:0 - 0.5wt%, Si: 0 - 1wt%, Mg: 0 - 1wt% Zr:0 - 0.5wt%, Ti: 0 - 1wt% Co:0 - 1wt% Ag:0 - 1wt% aluminum:0 - 5wt% B:0 - 0.5wt% Rare earth elements: 0 - 0.5wt%.
[0012] The heat treatment with which the 4th mode of invention is given after said fabricating operation is a copper alloy for electric lines or cable material characterized by being for 5 to 10000 seconds at the temperature of 200-800 degrees C.
[0013] As for the 5th mode of invention, said copper alloy for electric lines or cable material is nickel. : 1 - 4 wt%, Si : The remainder is the copper alloy for electric lines or cable material characterized by being the copper alloy which consists of Cu and unescapable impurities 0.1 - 1.0 wt%.
[0014] As for the 6th mode of invention, said copper alloy for electric lines or cable material is nickel. : 1 - 4 wt%, Si : 0.005 - 1wt% is included for one or more sorts further chosen from Sn, Mn, Mg and Zn, Ag, and Co in a total amount 0.1 - 1.0 wt%, and the remainder is Cu. And it is the copper alloy for electric lines or cable material characterized by being the copper alloy which consists of unescapable impurities.
[0015] As for the 7th mode of invention, said copper alloy for electric lines or cable material is Sn. : 0.5 - 3 wt%, P : 0.005 - 0.5 wt% and the remainder are Cu(s). And it is the copper alloy for electric

lines or cable material characterized by being the copper alloy which consists of unescapable impurities.

[0016] As for the 8th mode of invention, said copper alloy for electric lines or cable material is Sn. : 0.5 - 3wt%, P : 0.005 - 2wt% is included for one or more sorts further chosen from nickel, Mn, Fe, Cr, Mg, and Zn in a total amount 0.005 - 0.5 wt%, and the remainder is Cu. And it is the copper alloy for electric lines or cable material characterized by being the copper alloy which consists of unescapable impurities.

[0017] As for the 9th mode of invention, the copper alloy for electric lines or cable material is Sn. : 3 - 10 wt%, P : The remainder is the copper alloy for electric lines or cable material characterized by being the copper alloy which consists of Cu and unescapable impurities 0.005 - 0.5 wt%.

[0018] As for the 10th mode of invention, said copper alloy for electric lines or cable material is Sn. : 3 - 10 wt%, P : It is the copper alloy for electric lines or cable material characterized by being the copper alloy with which the remainder consists of Cu and unescapable impurities further one or more sorts chosen from nickel, Fe, and Zn including 0.005 - 2wt% in a total amount 0.005 - 0.5 wt%.

[0019] As for the 11th mode of invention, said copper alloy for electric lines or cable material is Zn. : 5 - 35 wt%, The remainder is the copper alloy for electric lines or cable material characterized by being the copper alloy which consists of Cu and unescapable impurities.

[0020] As for the 12th mode of invention, said copper alloy for electric lines or cable material is Zn. : It is the copper alloy for electric lines or cable material characterized by being the copper alloy with which the remainder consists of Cu and unescapable impurities further one or more sorts chosen from Sn, nickel, and Fe including 0.005 - 2wt% in a total amount 5 - 35 wt%.

[0021]

[Mode for carrying out the invention] As a copper alloy for electric lines or cable material, if the spring characteristics are excellent, ** will be required. Spring characteristics are estimated by the spring threshold value, and this is a bending stress value equivalent to the proof stress called for from a tensile test, and is defined as follows. A spring threshold value (Kb) is the surface maximum stress which produces permanent deformation equivalent to elastic deformation in case the surface stress by bending is set to 3E/8x104.

[0022] Low temperature annealing is known as a method of generally raising a spring threshold value. The Reason where low temperature annealing raises a spring threshold value is considered for the transposition produced in plastic working before low temperature annealing to carry out a rearrangement with heat treatment. So, in this invention, the arrangement of moderate plastic-working ****** transposition is disturbed beforehand, low temperature annealing proper after that tends to be given, and it is going to obtain the copper alloy member for electric lines or cable material excellent in spring characteristics.

[0023] The fundamental modes of invention are a fabricating operation and the thermomechanical treatment method of the copper alloy for electric lines or cable material which heat-treats after that. It is processed so that Vickers hardness (Hv) change of a processing part before and after carrying out the fabricating operation of said copper alloy for electric lines or cable material as a spring from raw

materials, such as a plate, or a rod, a line, etc., may become less than ten. Subsequently, when it heat-treats, it is the thermomechanical treatment method of performing heat treatment which makes Vickers hardness (Hv) change of said part before and after this heat treatment less than ten. A temper is performed so that change of hardness may become less than ten, when predetermined processing is performed with plastic working or heat treatment beforehand suitable when spring workability has become settled here.

[0024] Although it work hardens when bending is performed, and change arises in Vickers hardness (Hv), the part which acts as a spring cannot fully improve the characteristics as a spring with the heat treatment performed later, when the hardness change of an applicable part exceeds 10. This Reason is because the rearrangement of transposition is not fully made in subsequent low temperature annealing.

[0025] Next, the Reason which generally limited heat-treatment temperature with 200-800 degrees C is explained as conditions for the low temperature annealing as heat treatment. Since a work material softens too much at the temperature which cannot improve the characteristics of a spring part at the temperature below 200 degrees C, but exceeds 800 degrees C, it is because it is not suitable. Even if the high temperature of about 800 degrees C of metaphors made processing time 5 to 10000 seconds, it is because the processing which sufficient characteristics improvement effect is not accepted and exceeds 10000 seconds is softened too much by a case or an effect is saturated in less than 5 seconds.

[0026] According to the construction material of the copper alloy used as a spring member, desirable conditions differ between the above-mentioned processing temperature and processing time respectively, and they explain typical construction material and a typical processing condition below. As a copper alloy used for connectors, there is a Cu-nickel-Si system alloy (it is also called the Colson alloy). The alloy with which the remainder consists of copper substantially is known including 1 - 4wt% of nickel, and 0.1 - 1.0wt% of Si. The spring member of the copper alloy with which a 0.005-2wt% implication and the remainder consist of copper substantially is also known for the total amount in one or more sorts further chosen as the above-mentioned alloy from Sn, Mn, Mg and Zn, Ag, and Co. About these, 300-750 degrees C is an optimum temperature, and the processing time for 5 to 10000 seconds is desirable. Processing at less than 300 degrees C does not come out enough and have the characteristics betterment of a spring part, the processing conversely over 750 degrees C is before and after heat treatment, and hardness becomes soft and is not [ten or more] desirable [processing].

[0027] The brass system material currently that as a copper alloy used is explained. [most] About the spring member which the remainder becomes from copper substantially including 5 - 35wt% of Zn, 200-600 degrees C is an optimum temperature, and the processing time for 5 to 10000 seconds is desirable. Processing at less than 200 degrees C does not come out enough and have the characteristics betterment of a spring part, the processing conversely over 600 degrees C is before and after heat treatment, and hardness becomes soft and is not [ten or more] desirable [processing].

[0028] The heat treatment carried out after the fabricating operation which includes bending next is explained. Although a heat treatment condition changes strictly with work materials, respectively, if the ********-** hardness change before and behind heat treatment is -10 - 10 generally, a good member with little aging of a contact pressure can be manufactured. Here, the hardness before heat treatment is the hardness of the part which performed bending, and it must compare with the temper of the same part. When Vickers hardness change becomes soft exceeding 10, the setting at the time of insert and remove and stress relaxation become large too much and are unsuitable.

[0029] Moreover, the metallic material heat-treated for making age-hardening start is also like beryllium copper after the fabricating operation including bending. If bending is further performed for these metallic materials after age-hardening, it is too hard, and a crack is produced in a bending part and it cannot be normally processed into it. therefore, . which age-hardening processing is performed after bending in order to prevent a crack, but has 50 or more large hardness change with Vickers hardness (Hv) in this case -- as for the technology which carries out age-hardening after these bendings, unlike the invention in this application, said technology is not included in an application concerned from that technical meaning.

[0030] There is a copper alloy which has the following component composition as a metallic material which can apply the above-mentioned thermomechanical treatment. Namely, the copper alloy for electric lines or cable material with which the remainder consists of Cu and unescapable impurities including any one sort of the following component composition, or two sorts or more (in the following, it means additive-free "0 wt%").

Sn: 0 - 10wt%, Zn: 0 - 40wt%, nickel: 0 - 10wt% Fe:0 - 3wt%, Cr: 0 - 1wt%, Mn: 0 - 1wt% P:0 - 0.5wt%, Si: 0 - 1wt%, Mg: 0 - 1wt% Zr:0 - 0.5wt%, Ti: 0 - 1wt% Co:0 - 1wt% Ag:0 - 1wt% aluminum:0 - 5wt% B:0 - 0.5wt% Rare earth elements: 0 - 0.5wt%.

[0031] The above-mentioned alloy is indicated comprehensively. However, it is desirably applied to the copper alloy which more specifically has the following component composition.

nickel : 1 - 4 wt%, Si : The remainder is the copper alloy for electric lines or cable material characterized by being the copper alloy which consists of Cu and unescapable impurities 0.1 - 1.0 wt%. This alloy is an alloy called what is called a Colson alloy.

[0032] Moreover, it is nickel as said copper alloy for electric lines or cable material. : 1 - 4 wt%, Si : 0.005 - 1wt% is included for one or more sorts further chosen from Sn, Mn, Mg and Zn, Ag, and Co in a total amount 0.1 - 1.0 wt%, and the remainder is Cu. And the copper alloy which consists of unescapable impurities is also desirable.

[0033] Moreover, it is Sn as said copper alloy for electric lines or cable material. : 0.5 - 3 wt%, P : 0.1 - 1.0 wt% and the remainder are Cu(s). And the copper alloy which consists of unescapable impurities is also desirable.

[0034] Moreover, as said copper alloy for electric lines or cable material, it is Sn. : 0.5 - 3 wt%, P : 0.005 - 2wt% is included for one or more sorts further chosen from nickel, Mn, Fe, Cr, Mg, and Zn in a total amount 0.1 - 1.0 wt%, and the remainder is Cu. And the copper alloy which consists of unescapable impurities is also desirable.

[0035] Moreover, it is Sn as said copper alloy for electric lines or cable material. : 3 - 10 wt%, P : 0.005 - 0.5 wt% and the remainder are Cu(s). And it is applicable also to the copper alloy which consists of unescapable impurities.

[0036] Furthermore, said copper alloy for electric lines or cable material is Sn. : 3 - 10 wt%, P : 0.005 - 2wt% is further included for one or more sorts chosen from nickel, Fe, and Zn in a total amount 0.005 - 0.5 wt%, and the remainder is Cu. And it can be considered as the copper alloy which consists of unescapable impurities.

[0037] Furthermore, it is Zn as said copper alloy for electric lines or cable material. : 5 - 35 wt%, The remainder is Cu. And it can ** also using the copper alloy which consists of unescapable impurities.

[0038] Furthermore, it is Zn as said copper alloy for electric lines or cable material. : 0.005 - 2wt% is further included for one or more sorts chosen from Sn, nickel, and Fe in a total amount 5 - 35 wt%, and the remainder is Cu. And the copper alloy which consists of unescapable impurities can also be used.

[0039]

[An example 1] With the copper alloy (A:Colson alloy, B, C:bronze, D: brass) of the component composition indicated to Table 1 shown as drawing 4 , 0.25mm of board thickness material was processed into the female terminal of the form shown in drawing 1, and it heat-treated on condition of Table 2 shown as after-processing drawing 5 . Conventional parallel is the case where it does not heat-treat, and a comparative example is a case with unsuitable temperature or heat treatment time. The possible sealed type small electric furnace of rapid heating or forced cooling performed heat treatment. It carried out, where non-processed material is equipped with thermocouple in a non-oxidizing atmosphere.

[0040] Characterization performed setting of hardness and a spring part, and evaluation of the stress relaxation characteristic. Each valuation method is described.

In order to carry out by the part which acts as a spring and by which bending was carried out and to measure the hardness of a bending part, <hardness> measurement buried the work material to resin, and was performed in the section after polish. It bent from the center of board thickness in a bending part section, and three places were measured by the part of the radial outside. Moreover, three places were measured also about the part to which bending is not performed, and the hardness change before and behind bending was searched for by each average. Next, the Vickers hardness after heat treatment (Hv) was measured. A hardness test section is the above-mentioned bending part. The hardness change before and behind heat treatment was searched for according to the difference of each three-point average.

[0041] About five samples after <setting of spring part> heat treatment, the gap of gap ** shown by drawing 1 was measured two or more times, and the average A was calculated. Moreover, the male tab was inserted like drawing 2 after heat treatment, the gap of gap ** was similarly measured two or more times about five samples which carried out extraction of the male tab after 60-second maintenance, and the average B was calculated. And the difference of A and B was searched for and it was considered as the spring part setting after male tab insert and remove.

[0042] About five samples after <stress relaxation characteristic> heat treatment, the male tab was inserted and relief processing of 500 hours in 150 degrees C was performed in the state. It took out from the processing furnace after 500-hour progress, and extraction of the male tab was carried out, and the gap of gap ** shown in Enclosure I was measured, five averages C were calculated, said difference of A and C was searched for, and it was considered as the amount of reliefs.

[0043] The above-mentioned gap buried the terminal to resin, and measured it by observing the section after polish. The above-mentioned measurement result was described in Table 3 shown as drawing 6 . In addition, in the bending part of this example, the hardness change before and behind bending of any material of A-D was less than ten. According to Table 3 of drawing 6 , each of setting of a spring part and amounts of stress relaxation is inferior in conventional parallel No.14 which does not heat-treat after the fabricating operation including bending - 17. It turns out that example Noof this invention .1 which heat-treated after the fabricating operation - 13 show dramatically excellent characteristics.

[0044] moreover, . it turns out to be that temper is softer [ten or more] than processing before each of No.19 with high heat treatment temperature, and 20, 23, 25 and 27 at Hv, and the setting and the amount of reliefs of a spring part have also deteriorated greatly -- in this way It is important to heat-treat to the grade which a work material does not soften too much, and the optimal heat treatment condition changes with construction material.

[0045]

[An example 2] The test piece (I, RO, Ha) with which the hardness change in bending of said C material differs was prepared, and the same examination as an example 1 was done. The heat treatment condition was carried out on the same conditions as No.10 shown in the example 1. It is shown in Table 4 by making a result into drawing 7 . As for No.30 which were elasticity from the first, the hardness change before and behind bending was set to 12, and the characteristics as a spring were inferior compared with No.28 and No.29 which are an example of this invention. That is, it is the example which shows that the same processing also differs in the hardness change in bending depending on the heat treatment condition of the test piece before bending, and is inferior in spring characteristics on condition of besides this invention. As mentioned above, although this invention was limited to the copper alloy and explained, it is theoretically applicable to carbon steel, stainless steel, etc.

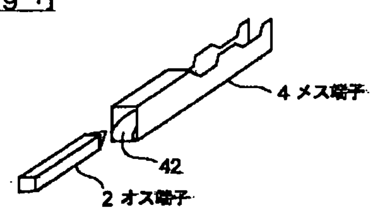
[0046]

[Effect of the Invention] If the thermomechanical treatment method of this invention is applied to the copper alloy for electric lines or cable material as described above, it is possible for the setting and the stress relaxation characteristic of a spring part to be improved, and to always continue keeping a contact pressure high. Moreover, although a temporal change of a contact pressure is small therefore, there is no need of designing an early contact pressure highly especially, therefore it can contribute also to lowering of an insertion mosquito. Moreover, the copper alloy which applied the above-mentioned thermomechanical treatment method can be used as electric lines or cable material for a long period of time. Therefore, this invention does an industrially remarkable contribution so.

[Brief Description of the Drawings]
[Drawing 1] It is drawing showing the example of form of the electric lines or cable material containing a spring.
[Drawing 2] It is drawing showing the state where the male part and the Metz part of the electric lines or cable connected.
[Drawing 3] It is drawing showing the part which measured the hardness of the member by which bending was carried out.
[Drawing 4] It is drawing showing the examined alloy-content composition as Table 1.
[Drawing 5] It is drawing showing the examined heat treatment temperature as Table 2.
[Drawing 6] They are the hardness change before and behind the examined heat treatment, the setting of a spring part, and drawing showing the amount of reliefs.
[Drawing 7] It is drawing showing the relation between the hardness change before and behind bending at the time of carrying out bending as a spring, and spring characteristics as Table 4.
[Explanations of letters or numerals]
2 Terminal Area Male Terminal
4 Female Terminal of Terminal Area
42 Tongue-shaped Piece of Female Terminal

[Drawing 1]

(A)



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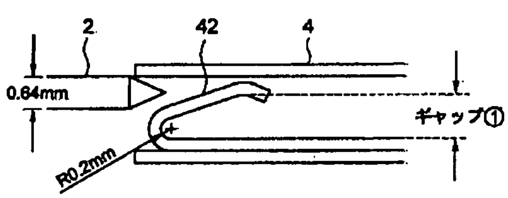
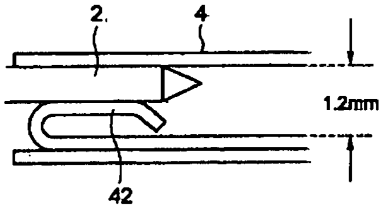


[Drawing 2]



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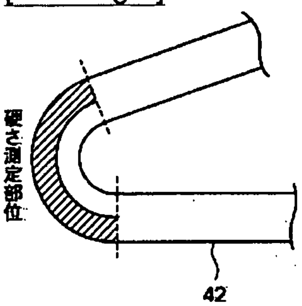

[Drawing 4]

表1

	成分（wt%）
A材	Cu-2.5%Ni-0.6%Si-0.5%Zn-0.2%Sn-0.1%Mg
B材	Cu-2%Sn-1%Ni-0.05%P
C材	Cu-8%Sn-0.03%P
D材	Cu-30%Zn

[Drawing 7]

表4

	No.	使用材	調質	曲げ加工前後硬さ変化(Hv)	熱処理前後硬さ変化(Hv)	ばね部へたり(mm)	緩和量(mm)
本発明例	28	C材	イ	2	-2	0.06	0.14
	29	C材	ロ	6	-1	0.09	0.12
比較例	30	C材	ハ	12	-2	0.21	0.24

[Drawing 5]

表2

	No.	使用材	熱処理条件	
			温度(℃)	時間(sec)
本発明	1	A材	400	3600
	2	A材	400	60
	3	A材	400	300
	4	A材	450	300
	5	A材	500	300
	6	A材	650	10
	7	B材	280	3600
	8	B材	330	300
	9	B材	450	300
	10	C材	330	300
	11	C材	400	60
	12	D材	230	300
	13	D材	350	60
従来例	14	A材	熱処理無し	
	15	B材	熱処理無し	
	16	C材	熱処理無し	
	17	D材	熱処理無し	
比較例	18	A材	250	3600
	19	A材	820	5
	20	A材	800	2
	21	A材	350	18000
	22	B材	220	7200
	23	B材	730	5
	24	C材	180	7200
	25	C材	690	5
	26	D材	180	7200
	27	D材	630	5

[Drawing 6]

表3

	No.	使用材	熱処理前後硬さ変化(Hv)	ばね部へたり(mm)	緩和量(mm)
本発明	1	A材	3	0.04	0.09
	2	A材	-1	0.06	0.12
	3	A材	1	0.05	0.10
	4	A材	2	0.05	0.09
	5	A材	-1	0.04	0.08
	6	A材	-3	0.05	0.10
	7	B材	-2	0.06	0.13
	8	B材	-2	0.07	0.13
	9	B材	-4	0.06	0.12
	10	C材	-2	0.06	0.14
	11	C材	-4	0.06	0.15
	12	D材	-2	0.08	0.18
	13		-3	0.09	0.19
従来例	14	A材	—	0.09	0.17
	15	B材	—	0.11	0.20
	16	C材	—	0.10	0.22
	17	D材	—	0.13	0.28
比較例	18	A材	1	0.08	0.16
	19	A材	-105	0.21	0.32
	20	A材	-47	0.19	0.29
	21	A材	4	0.06	0.13
	22	B材	0	0.11	0.21
	23	B材	-34	0.25	0.37
	24	C材	-1	0.09	0.22
	25	C材	-69	0.22	0.41
	26	D材	-2	0.13	0.28
	27	D材	-44	0.27	0.49

[Translation done.]